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FINAL
FIELD SAMPLING REPORT
in SUPPORT of RISK ASSESSMENT at
OGDEN RAIL YARD
OGDEN, UTAH
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LIST OF ACRONYMS

AAS	Atomic Absorption Spectroscopy
AET	Adverse Effects Threshold
ANOVA	Analysis of Variance
AOI	Area of Interest
As	Arsenic
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
AVS	Acid Volatile Sulfide
AWQC	Ambient Water Quality Criteria
BC	Burch Creek
bgs	Below Ground Surface
BTAG	Biological Technical Assistance Group
BVPP	Buena Ventura Park Pond
BW	Body Weight
°C	Degrees Centigrade
Cd	Cadmium
CEC	Cation Exchange Capacity
cfm	Cubic Feet per Minute
cfs	Cubic Feet per Second
cm	Centimeter
COC	Contaminant of Concern or Chain of Custody
COPC	Contaminant of Potential Concern
Cr	Chromium
Cu	Copper
CV	Coefficient of Variation
CV/AAS	Cold-Vapor Atomic Absorption Spectroscopy
CWA	Clean Water Act
d	day
DL	Detection Limit
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DQO	Data Quality Objectives
d.w.	Dry Weight
EA	Endangerment Assessment
e.g.	For Example (exampli gratia)
EPA	Environmental Protection Agency
EqP	Equilibrium Partitioning
ERA	Ecological Risk Assessment
ER-L	Effects Range - Low
ER-M	Effects Range - Median
ERTC	Environmental Response Team Center
et al.	And Others
etc.	And So Forth (et cetera)
FAAS	Flame Atomic Absorption Spectroscopy
FS	Feasibility Study
ft	Feet, Foot
g	Gram
GW	Ground Water
ha	Hectare

HASP	Health and Safety Plan
HDPE	High Density Polyethylene
Hg	Mercury
HQ	Hazard Quotient
hr	Hour
Hwy	Highway
IC	Ion Chromatography
ICAP	Inductively Coupled Argon Plasma
ICP	Inductively Coupled Plasma
i.e.	That is (id est)
K_d	Dissociation Coefficient
kg	Kilogram
L	Liter
LC50	Lethal Concentration that Results in 50% Mortality
LD50	Lethal Dose that Results in 50% Mortality
LEL	Lowest Effect Level
LOAEL	Lowest Observable Adverse Effect Level
LOQ	Limit of Quantitation
LPL	Lower Prediction Limit
m	Meter
MAR	March
MDL	Method Detection Limit
µg/µL	Microgram/microliter
mg/mL	Milligram/milliliter
mL	Milliliter
mm	Millimeter
MQL	Method Quantitation Limit
MSL	Mean Sea Level
NA	Not Applicable
NC	No Criteria
ND	Not Detected
Ni	Nickel
NOAEL	No Observable Adverse Effect Level
NPDES	National Pollution Discharge Elimination System
NPL	National Priority List
NTU	Nephelometric Turbidity Units
OMOE	Ontario Ministry of the Environment
OR	Ogden River
ORY	Ogden Rail Yard
Pb	Lead
ppb	Parts per Billion
ppm	Parts per Million
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
QAWP	Quality Assurance Work Plan
RD	Roundhouse Ditch
REAC	Response Engineering and Analytical Contract
ROD	Record of Decision
RPM	U.S. EPA Remedial Project Manager

S	Soil
SC	Strongs Creek
Se	Selenium
SE	Standard Error
33SS	33rd Street Slough
SSC	Site Safety Coordinator
21SP	21st Street Pond
SW	Surface Water
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TF	Tissue Fish
TI	Tissue Invertebrate
TLm	Median Tolerance Level
TOC	Total Organic Carbon
TSS	Total Suspended Solids
U.S.	United States
USACOE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
WA	Work Assignment
WAM	Work Assignment Manager
WP	Work Plan
WR	Weber River
w.w.	Wet Weight
Zn	Zinc

EXECUTIVE SUMMARY

The Ogden Rail Yard site is located in Weber County, UT, on the western edge of the city of Ogden. The rail yard is oriented in a north-south direction, consisting of a distance of approximately 5.5 kilometers (3.4 miles) along the east bank of the Weber River. The site is currently owned and operated by the Union Pacific Railroad . The Ogden Rail Yard Site was the location of a major maintenance area for the Union Pacific Railroad. The area uses included roundhouses, fuel storage, engine repair, and waste treatment facilities (U.S. EPA 1999).

The objective of this effort was to assist in the generation of site-specific ecological and contaminant data for the Ogden Rail Yard site; and to generate a technical data evaluation for the aquatic components of the site. Within this effort, field samples (abiotic and biotic) were collected to assist in filling data gaps initially for the completion of a screening risk assessment.

All sampling conducted within this investigation was conducted as described below; however, most of the soil, sediment and water samples were transferred under chain-of-custody to consultants of the Union Pacific Railroad for chemical analyses. Only approximately 10% of the abiotic samples were retained for independent analyses, as described below. All biotic samples (i.e. fish tissues), toxicity testing samples and biological survey samples were retained for evaluation. Sample analyses data and sampling location information were transferred to the consultants of the Union Pacific Railroad, with the understanding that they would compile all abiotic data and develop site maps.

Sampling locations were focused on the east bank of the Weber River, associated with the Ogden Rail Yard site; and a total of 9 samples were also collected from the Ogden River. There were 19 surface water and sediment samples collected from the Weber River, 15 from the 21st Street Pond, 3 from the Buena Ventura Park Pond, 3 from the Ogden River, 3 from the Roundhouse drainage ditch, 2 from Area of Interest 10, 3 from the 33rd Street Slough, and 4 from each of the remaining locations (Burch Creek and Strongs Creek).

At 7 of the surface water and sediment sampling locations a stream benthic macroinvertebrate survey was conducted as well as solid phase sediment laboratory toxicity tests utilizing two species: chironomids (*Chironomus tentans*) and amphipods (*Hyalella azteca*).

Because of the need for tissue analysis to evaluate the potential transfer of CPOCs to humans and piscivorous organisms, fish were collected from the 21st Street Pond. Prior to necropsy and filet collection, individual fish were examined for external parasites, lesions, and tumors. Samples of filets, carcasses, and livers of five species representative of the site (i.e. brook trout, rainbow trout, largemouth bass, common carp, and white sucker) were collected for analyses.

Sampling of surface soil chemistry was identified as a data need to support the ecological risk analyses for the Weber River riparian area. Samples were collected from most of the length of the riparian zone on the east side of the Weber River and the perimeter of the 21st Street Pond. The sampling design assumed that the perimeter of the 21st Street Pond was as one exposure unit, and the WR riparian area was divided into four exposure units. Ten randomly selected sampling locations were selected in each of the four exposure units along the Weber River. Additionally, there were 7 sampling locations from the 21st Street Pond perimeter exposure unit.

In addition, one sediment/soil sample, from a visible discharge of groundwater from the perimeter of the 21st Street Pond, was collected to assist in the chemical analysis of the sediments collected from the 21st Street Pond and Ogden River.

Surface waters collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, VOCs, Total Petroleum Hydrocarbons (TPH), hardness, TSS, and TOC.

Surface water contained detectable concentrations of aluminum, arsenic, barium, lead, and manganese; however, cadmium, chromium, cobalt, copper, mercury, nickel, selenium, and silver were not detected in surface water samples analyzed.

Surface water samples collected did not have detectable concentrations of BNAs and acetone was the only VOC found (also found in the blank) in surface water samples, with the exception of the water sample from the seep on the bank of the 21st Street Pond. That particular sample (A0119-0325) was found to contain: 120 µg/L benzene, 230 µg/L ethylbenzene, 59 µg/L p&m-xylene, 90 µg/L o-xylene, 12 µg/L isopropylbenzene, 63 µg/L 1,3,5-trimethylbenzene, 64 µg/L 1,2,4-trimethylbenzene, and 180 µg/L naphthalene.

The water samples analyzed were found to have no detectable TPH concentrations.

Sediments collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, pesticides/PCBs, VOCs, TPH, TOC, and grain size.

Aluminum concentrations ranged from 920 mg/kg (AOI 4A) to 15,000 mg/kg in sediments from the 21st Street Pond (21SP04). Sediment arsenic concentrations were greatest at AOI 4 (6.1 mg/kg) and least at the 21st Street Pond seep (1.4 mg/kg). Barium concentrations ranged from 49 mg/kg (33SS2A) to 400 mg/kg (AOI 4A). Cadmium was not detected in many of the locations and the maximum recorded was 1.0 mg/kg (AOI102A). Sediment chromium concentrations ranged from 4.4 mg/kg (AOI4A) to 31 mg/kg (SC1A). The maximum recorded cobalt concentration, 7.7 mg/kg, was from a sample from the 21st Street Pond (21SP04). A sediment sample from the 33rd Street Slough (33SS2A) contained the highest copper concentration, 130 mg/kg. Lead concentrations in sediment samples ranged from 6.8 mg/kg (BC3A) to 130 mg/kg (SC1A). The maximum recorded manganese concentration, 960 mg/kg, was from a sample from the 21st Street Pond (21SP04). The sediment mercury concentrations ranged from non-detected to 0.39 mg/kg (BVP03B). Nickel concentrations ranged from 3.6 mg/kg (WR021ADUP) to 20 mg/kg (21SP04B). The maximum detected sediment selenium and vanadium concentrations were 5.0 mg/kg (AOI4A) and 24 mg/kg (21SP04B), respectively. Sediment zinc concentrations were as low as 33 mg/kg (OR02B) and as high as 200 mg/kg (RD3A). Antimony and silver were not detected in sediment samples analyzed.

The following BNAs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, carbazole, fluoranthene, pyrene, bis)2-ethylhexyl)phthalate, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. A tentatively identified compound (TIC) was recorded for the sediment/soil sample from the seep at the 21st Street pond. It was identified as a biphenol (920 µg/kg). Bis(2-ethylhexyl)phthalate was also found in the sediment samples from the Ogden River, Buena Ventura Park Pond, and 21st Street Pond.

Two pesticides were identified in sediments from the area. Locations SC1A and 33SS2A were found to contain g-chlordane, while p,p'-DDE was measured in sediments from 21st Street Pond seep (12 µg/kg), 21st Street Pond (4.9 to 9.4 µg/kg), and the Weber River (WR019A, 7.3 µg/kg). Only one PCB congener was positively identified. Arochlor 1260 was found at concentrations of 340 µg/kg and 1,000 µg/kg from AOI 10-2 and OR02B, respectively.

The following VOCs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): methylene chloride, benzene, 2-butanone, 4-methyl-2-pentanone, toluene, p-isopropyltoluene, naphthalene, ethylbenzene, p&m-xylene, o-xylene, isopropylbenzene, n-propylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and sec-butylbenzene. Benzene (46 µg/kg) and related compounds were found in the sediment/soil (A0119-0324) from the seep at the 21st Street Pond.

Concentrations of TPH in sediments analyzed ranged from 170 mg/kg (BC3A) to 2,200 mg/kg (WR024A).

The results of the survival and growth effects on *H. azteca* and *C. tentans* observed in the site sediments suggest the absence of adverse effects associated the sediments from the Weber River, with the possible exception of one location which was the furthest downstream of the site. The sediment and water chemistry data for the location do not explain the mortality observed. While the results of these tests can not be discounted, it should be recognized that the observed effects were not large relative to the laboratory control.

The stream macrobenthic community evaluation conducted in the Weber River, and co-located with the toxicity testing, does not indicate any site specific impact on the stream community. These results are consistent with the findings of the toxicity testing conducted.

There were seven BNAs identified in the fish tissue samples, with the most BNA contaminants found in white sucker and common carp filets and carcasses.

There were 5 pesticides (g-chlordane, dieldrin, p,p'-DDE, p,p'-DDD, p,p'-DDT) and one PCB congener (Arochlor 1260) residues identified in the fish tissues from the 21st Street Pond .

Two common carp filets (5.3 µg/kg, 20 µg/kg, w.w.) and one carcass (40 µg/kg, w.w.) were found to contain g-chlordane. Dieldrin was only detected in the carcasses of two trout, a brook trout (3.1 µg/kg, w.w.) and a rainbow trout (2.6 µg/kg, w.w.).

The relatively high PCB concentrations found in the fish from the 21st Street Pond (up to 4 ug/g wet wt. in a carp carcass), combined with the low sediment PCB concentrations found in the sediment suggest that the source of the PCBs is outside of the 21st Street Pond.

Surface soils did not contain unusually high concentrations of any TAL metal, with most of the highest metal concentrations coming from the upstream riparian zone. Bis(2-ethylhexyl)phthalate, benzo(g,h,i)perylene, chrysin, and many unknown tentatively identified compounds (TICs) were the only BNAs found in surface soils; mostly found in samples from the riparian area between Interstate 79 and north of AOI 12 (RZ-1). Only the surface soil from location RZ106 was found to contain Arochlor 1260, at a concentration of 260 ug/kg. The only pesticide detected, p,p'-DDE(1.8 µg/kg) was found in the soil from location RZ407. Few of the surface soil samples were found to contain VOCs. However, acetone, chloroform, trichlorofluoromethane, and chlorodifluoromethane were detected a limited quantity in various samples.

1.0 INTRODUCTION

1.1 Objectives of this Study

The objective of this effort was to assist in the generation of site-specific ecological and contaminant data for the Ogden Rail Yard site, Ogden, Utah (UT); and to generate a technical data evaluation for the aquatic components of the site.

1.2 Site Background

The Ogden Rail Yard site is located in Weber County, UT, on the western edge of the city of Ogden. The rail yard is oriented in a north-south direction, consisting of a distance of approximately 5.5 kilometers (3.4 miles) along the east bank of the Weber River.

The site is currently owned and operated by the Union Pacific Railroad . The Ogden Rail Yard Site was the location of a major maintenance area for the Union Pacific Railroad. The area uses included roundhouses, fuel storage, engine repair, and waste treatment facilities. It is suspected that significant subsurface contamination exists and that several migration and release pathways may be present and affecting terrestrial areas as well as adjacent water bodies, including the Weber River (U.S. EPA 1999).

2.0 METHODOLOGY

Within this effort, field samples (abiotic and biotic) were collected to assist in filling data gaps initially for the completion of a screening risk assessment. Copies of chain of custody forms are found in Appendix A. Descriptions of site reconnaissance and field activities are found in Appendix B.

All sampling conducted within this investigation was conducted as described below; however, most of the soil, sediment and water samples were transferred under chain-of-custody to consultants of the Union Pacific Railroad for chemical analyses. Only approximately 10% of the abiotic samples were retained for independent analyses, as described below. All biotic samples (i.e. fish tissues), toxicity testing samples and biological survey samples were retained for evaluation.

Sample analyses data and sampling location information were transferred to the consultants of the Union Pacific Railroad, with the understanding that they would compile all abiotic data and develop site maps.

2.1 Technical Approach

2.1.1 Habitat Evaluation

The in stream and riparian habitat was evaluated at all sampling locations in the Weber River to support the biological survey per Environmental Response Team (ERTC)/Response Engineering and Analytical Contract (REAC) Standard Operating Procedure (SOP) #2032 *Benthic Macroinvertebrate Sampling* and EPA (1990b, 1997b). Habitat parameters pertinent to the assessment of biological quality include those that characterize the stream micro- and macro scale habitat and influence the structure of the biological community. These include epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles (or bends), bank stability, bank vegetative protection, and riparian vegetative zone width (Table 1). For every location, the procedure assigned a numeric value for each habitat parameter individually, with the highest scores awarded to locations with best quality habitat. The values were summed for total habitat score, with the highest scores awarded to locations with best quality habitat.

The total score for each location was compared to a reference location to provide a habitat comparability score; Weber River location WR09 was used as the reference location. The habitat comparability score is a ratio of the total score for a location to the total score for the reference. The comparability scores are associated with verbally descriptive assessment categories which include: "comparable to reference", "supporting", "partially supporting", and "non-supporting" (Table 1).

2.1.2 Aquatic Sampling

2.1.2.1 Sampling Locations

To the maximum extent possible, sampling locations for surface water, sediment, and benthic macroinvertebrates were collocated to decrease costs and increase interpretive powers. The locations were situated in areas exhibiting similar habitat characteristics including substrate composition, riparian vegetation, topographic relief, channel morphology, flow velocity, watershed features, and land use. Sampling locations were focused on the east bank of the Weber River, associated with the Ogden Rail Yard site, to evaluate the site's potential for release of contamination to the Weber River. Samples were also collected from the Ogden River to evaluate the possibility of contaminant release at a total of 9 selected locations (See Figure 1):

- Weber River (WR) upstream, adjacent to, and downstream of the Ogden Rail Yard
- 21st Street Pond (21SP)
- Buena Ventura Park Pond (BVPP)
- Burch Creek (BC)
- Strongs Creek (SC)
- 33rd Street Slough (33SS)
- Area of Interest #10 (AOI 10)
- Roundhouse drainage ditch (RD)
- Ogden River (OR) upstream, adjacent to, and downstream of the 21st Street Pond

2.1.2.2 Surface Water Sampling

Surface water was collected at all sampling locations per ERTC/REAC SOP #2013, *Surface Water Sampling* directly into the appropriate container by hand. To avoid the incidental incorporation of suspended sediment into the sample, water was collected prior to other sampling activities that may disturb the sediment: in addition sampling began downstream and proceeded upstream. Water samples were collected at half the maximum depth at each sampling location. Those samples from the Weber River were collected approximately one meter (m) from the east bank, which was adjacent to the Ogden Rail Yard. Those samples from the Ogden River were collected approximately 1 m from the south bank, which was adjacent to the 21st Street Pond.

There were 19 surface water samples collected from the Weber River, 15 from the 21st Street Pond, 3 from the Buena Ventura Park Pond, 3 from the Ogden River, 3 from the Roundhouse drainage ditch, 2 from Area of Interest 10, 3 from the 33rd Street Slough, and 4 from each of the remaining locations (Burch Creek and Strongs Creek).

2.1.2.3 Water Quality Measurements

Water quality parameters were measured using a Hydrolab Surveyor 4*a* Water Quality Management System™. The Hydrolab was used to measure temperature (degrees centigrade, °C), pH, dissolved oxygen (DO, mg/L), conductivity (microohms, μmhos), oxidation-reduction potential (volts, V), and turbidity (Nephelometric Turbidity Units, NTU). The Hydrolab was calibrated prior to data collection and after data collection was complete. The Hydrolab was used in accordance with the manufacturer's operating manual.

2.1.2.4 Sediment Sampling

Sediment was collected from 19 locations on the Weber River and collocated with surface water samples. Sampling locations were in identified depositional areas, determined to contain a volume of sediment sufficient to fulfill the analytical requirements. The collection area for any one sample did not exceed a 6 m reach of the river. Sediment was collected per ERTC/REAC SOP #2016, *Sediment Sampling*. Sediment samples were collected using a ponar or decontaminated trowels (as appropriate to reduce the loss of fine sediment particles). It was frequently necessary to composite sediment from several collocated grabs in a stainless steel bucket, to obtain sufficient material to meet analytical requirements. The bulk sample was covered and returned to a staging area. Prior to homogenization, aliquots for VOC analyses were dispensed into appropriate sample containers. After the sample was thoroughly mixed, aliquots for remaining laboratory analyses were dispensed into appropriate sample containers. All unused sample material was returned to the site.

There were 19 sediment samples collected from the Weber River, 15 from the 21st Street Pond, 3 from the Buena Ventura Park Pond, 3 from the Ogden River, 3 from the Roundhouse drainage ditch, 2 from area of interest 10, 3 from the 33rd Street Slough, and 4 from each of the remaining locations (Burch Creek and Strongs Creek).

2.1.2.5 Benthic Macroinvertebrate Sampling

A stream benthic macroinvertebrate survey was conducted at 7 sampling locations along the Weber River (WR09, WR011, WR012, WR014, WR019, WR024, WR028). These samples were taken as one method of evaluation of the ecological integrity of the Weber River. Rapid Bioassessment Protocols (RBP) were used to identify and evaluate the abundance and distribution of habitat and ecological communities (U.S. EPA 1990b, 1997b). Sampling locations were situated in areas that typify the drainage (i.e. representativeness) and were likely to yield representative specimens of benthic macroinvertebrates. In order to assure similarities of habitat among locations, the same personnel selected and sampled the sites. The survey followed draft ERTC/REAC SOP #2032 *Benthic Macroinvertebrate Sampling* and U.S. EPA protocols (1990b, 1997b).

Three replicate collections (2 minutes each) were made with a D-net, from the 7 locations on the Weber River (21 total samples). To facilitate comparisons, an equivalent level of effort was expended in riffle areas consisting of a heterogeneous assortment of gravel to cobble-sized particles. The stream bottom upstream of the net was disturbed to a depth of

approximately 5 centimeters (cm). Organisms and debris thus dislodged were swept into the net by the current. Following this, clean water was carefully poured or swept through the net to wash fine sediment particles from the contents. The samples were transferred from the net to a 500-milliliter (ml) polyethylene bottle and preserved with isopropyl alcohol.

Due to the large number of organisms present in each sample, sub-sampling was performed according to U.S. EPA methods (USEPA 1999). The alcohol was decanted from the sample and examined for organisms. If any were found, they were returned to the main sample. The sample was then placed into a plastic tray marked into even divisions, approximately 6 cm square. Each square was numbers sequentially. Water was added to the tray, and the detritus carefully distributed evenly throughout the tray. A random number table was used to select a sampling square. All detritus and organisms were removed from the selected square and placed into a glass tray underlit by a light source. Organisms in the sub-sample were then gently removed and placed into labeled glass vials containing 70% methanol. If fewer than 100 organisms were recovered from the square, additional squares were randomly selected until at least 100 organisms were recovered. The remaining detritus was replaced into the original sampling container along with the alcohol. This procedure was repeated for all 21 samples. All samples were returned to Lockheed Martin/REAC for archiving.

Organisms in each sample were identified to lowest practical taxon, genus in most cases, using commonly accepted taxonomic references (Wiggins 1996; Merrit and Cummins 1996; or Peckarsky 1990). Chironomid larvae and oligochaetes were counted but not identified further. Exuviae, empty shells, and pieces of larvae without heads were not included in counts. The number of each taxa found in each sample was noted on a bench sheet. Occasionally organisms were recovered that were damaged to the point that full identification was not possible. In this case, notes were provided on the benchsheets. Identified organisms were returned to vials and preserved in 70% ethanol. All vials were returned to Lockheed Martin/REAC for archiving.

The total number of organisms present and the number of distinct taxa identified are presented. The functional group of each taxa was determined by using the tables in Merritt and Cummins 1996 and U.S. EPA 1999. The number of scrapers and filterers were determined and used to evaluate the scraper:filterer ratio. Species diversity in each sample was evaluated using Shannon's H'. The number of organisms in the orders Plecoptera, Ephemeroptera, and Trichoptera were determined and compared to the numbers of organisms in the family Chironomidae to evaluate the EPT:Chironomid ratio. The percent contribution of the dominant taxon was calculated by dividing the number of organisms in the most abundant taxon by the total number of organisms collected. All calculations were performed using Microsoft Excel. Hilsenhoff's biotic index was conducted according to Hilsenhoff (1987) and Hilsenhoff (1988) with the modifications suggested by the U.S. EPA's Rapid Bioassessment Protocol (EPA 444/4-89/001 and EPA 841-B-99-002).

In order to determine the biological condition at each station, the metrics were averaged across the three replicates (or recalculated, depending on the metric) and the result tabulated for each of the seven stations. The condition score at each station was then compared to the score at the reference (Station 1, Location WR09) and evaluated using the criteria in U.S. EPA protocol (1989).

2.1.2.6 Fish Collection

Because of the need for tissue analysis to evaluate the potential transfer of CPOCs to

humans and piscivorous organisms, fish were collected from the 21st Street Pond, using a boat-mounted electrofisher, with the assistance of the State of Utah's fisheries biologists. Stunned fish were collected with dip nets and placed into coolers containing site water until processing. Fish were collected from the entire pond area by making concentric passes around the pond, until the target number of specimens had been reached. The sampling crew taxonomically identified the fish and recorded the wet weight (whole body, carcass, and liver) and length (total, fork, and standard) of the fish, as per ERTC/REAC SOP #2039, *Fish Handling and Processing*. Prior to necropsy and filet collection, individual fish were examined for external parasites, lesions, and tumors. Filets, carcasses, and livers were wrapped in aluminum foil, placed in a plastic bag, and placed on wet ice for 16 hours prior to being frozen with dry ice. Five species representative of the site (i.e. brook trout, rainbow trout, largemouth bass, common carp, and white sucker) were collected for analyses, with the following total length ranges: brook trout (20-40 cm), rainbow trout (21-40 cm), largemouth bass (24-41 cm), common carp (47-59 cm), and white sucker (42-55 cm). There were 3 individuals each of brook trout and rainbow trout, 6 largemouth bass, and 5 each of common carp and white sucker collected. Each fish had a filet (skin on) removed for analyses. The remaining carcass was analyzed to obtain whole-body burden data. Livers from each fish of a species were composited for analyses. In addition, there were seven (whole-body) samples of a forage fish species (bluegill, perch, crappie, red-sided shiner, and juvenile largemouth bass) were collected for tissue residue analyses. Following inspection of the filets by a Union Pacific Railroad representative, tissues were shipped on dry ice, via overnight delivery to the analytical lab.

2.1.2.7 Toxicity Evaluations

Laboratory toxicity tests were conducted using site sediment with the following species, commonly utilized in sediment toxicity evaluations: chironomids (*Chironomus tentans*) and amphipods (*Hyalella azteca*).

Solid-phase sediment toxicity evaluations using *C. tentans* and *H. azteca* were employed to provide data concerning the availability and toxicity of contaminants present in the sediment as per ERTC/REAC SOP #2051, *Ten Day Renewal Test for Determining Acute Toxicity of Sediments To The Freshwater Amphipod Hyalella azteca and the Midge Chironomus tentans*. Sediment for the solid–phase toxicity evaluations were collected from seven of the Weber River sediment sampling locations (collocated with the benthic community survey locations). These organisms often comprise a significant proportion of the benthic biomass and are an important component of the aquatic community. In addition to being in intimate physical contact with the substrate, *C. tentans* and *H. azteca* feed on detrital matter and vegetative debris incorporated into the sediment. Each sediment toxicity test consisted of eight replicates per sample location using 100 percent site sediment (no dilutions were used), and a control. Overlying water for the tests were of a quality consistent with that of the mean site waters (i.e., alkalinity, hardness, pH, and Ca^{2+}:Mg^{2+} ratio). In addition, a concurrent standard reference toxicity test was conducted for each organism.

2.1.3 Terrestrial Sampling

2.1.3.1 Sampling Locations

Sampling of surface soil chemistry was identified as a data need to support the ecological risk analyses for the Weber River riparian area. Samples were collected from most of the length of the riparian zone (RZ) on the east side of the Weber River and the perimeter of the 21st

Street Pond. The sampling design assumed that the perimeter of the 21st Street Pond was as one exposure unit, and the WR riparian area was divided into four exposure units:

- RZ-1 (the portion south of Interstate 79 and north of AOI 12);
- RZ-2 (the area to the north of Interstate 79 and south of the 24th Street overpass);
- RZ-3 (the area to the north of the 24th Street overpass and south of the 21st Street overpass); and
- RZ-4 (background riparian area of the WR).

In RZ-1 and RZ-2, sampling in AOI 27 and AOI 34 was determined to be not needed as these two AOIs were anticipated to be investigated as part of other efforts.

Surface soil sampling was confined to the east side of the Weber River, since contaminant migration to the west side riparian zone soils was not expected. Ten randomly selected sampling locations were selected per exposure unit in RZ-1, RZ-2, RZ-3, and RZ-4. Additionally, there were 7 sampling locations from the 21st Street Pond perimeter exposure unit.

2.1.3.2 Surface Soil Collection

Surficial soil (0 to 15 centimeters below ground surface) was collected from the five exposure units (four Weber River riparian zones and the perimeter of 21st Street Pond) using a dedicated, appropriately decontaminated stainless steel trowel per Environmental Response Team (ERTC)/Response Engineering and Analytical Contract (REAC) Standard Operating Procedure (SOP) #2012, *Soil Sampling*. Individual grabs were placed into a stainless steel (SS) bucket and homogenized. For VOC analyses an alternate methodologies for collection of soil samples was employed, the EnCore® sampling device. Aliquots for remaining laboratory analyses were dispensed into appropriate sample containers and all unused sample material was returned to the site.

2.1.3.3 Seep Sediment/Groundwater Collection

One sediment/soil sample, from a visible discharge of groundwater from the perimeter of the 21st Street Pond, was collected (ERTC/REAC SOP #2012, *Soil Sampling*) to assess point source loading of contaminants to the 21st Street Pond and Ogden River. The results of the chemical analyses were utilized to focus the selection of analytes for the sediments of the 21st Street Pond.

2.2 Sampling Equipment Decontamination

The following sampling equipment decontamination procedure was employed prior and subsequent to sampling each location in the following numerical sequence:

1. physical removal
2. nonphosphate detergent wash (Liquinox)
3. potable water rinse
4. distilled/deionized water rinse
5. 10% nitric acid rinse
6. solvent rinse (Acetone)
7. distilled water rinse
8. air dry

There were exceptions to this decontamination procedure. The ponar utilized in the collection of sediments from the 21st Street Pond and Buena Ventura Park Pond only underwent step one, physical removal, of the procedure. The ponar was completely decontaminated at the end of each sampling day and between the Buena Ventura Park Pond and 21st Street Pond sampling activities. The potential for cross sample contamination from the highly contaminated sediment locations was evaluated from the perspective of the sequence of sample collection. It was determined that the potential for cross contamination did not distort the evaluation of the contamination distribution in the sediments.

2.3 Standard Operating Procedures

2.3.1 Sample Documentation

Sample documentation was completed per the following ERTC/REAC SOPs:

- ERTC/REAC SOP #2002, *Sample Documentation*
- ERTC/REAC SOP #4005, *Chain of Custody Procedures*

2.3.2 Sample Packaging and Shipment

Sample packaging and shipment was conducted in accordance with the following ERTC/REAC SOP:

- ERTC/REAC SOP #2004, *Sample Packaging and Shipment*

2.3.3 Sampling Techniques

Field activities were conducted in accordance with the following SOPs:

- ERTC/REAC SOP #2013, *Surface Water Sampling.*
- ERTC/REAC SOP #2016, *Sediment Sampling.*
- ERTC/REAC SOP #2032 *Benthic Macroinvertebrate Sampling*
- ERTC/REAC SOP# 2041, *Operation of the Hydrolab Surveyor II Water Quality Management System*
- ERTC/REAC SOP # 2055, *10-Day Renewal Test for Determining Acute Toxicity of Sediments to the Freshwater Amphipod, Hyalella azteca and the Midge, Chironomus tentans.*

2.4 Waste Disposal

Investigative derived waste (i.e. PPE) was disposed of in accordance with all state and federal regulations. All of the treated and untreated samples will be maintained for 60 days after the issuance of this final report. If no additional testing has been requested at the end of the 60 days, with the approval of the Task Leader, arrangements will be made for disposal.

3.0 RESULTS

The abiotic (sediment, soil and water) chemical data presented herein constitute approximately 10% (U.S. EPA split portion) of all samples collected and analyzed. The chemistry data for the sediment samples which had laboratory toxicity testing also conducted are included, as well as the chemical analysis data for the tissue samples collected. All abiotic chemistry data was compiled through the consultants for Union Pacific Railroad, these data may be found in the following reports:

Data Summary Report.
Samples Collected Through July 2000
Union Pacific Railroad Company
Ogden, Utah
December 19, 2000

and

Draft Interim Remedial Investigation report
AOI - 33, 21 Street Pond
Union Pacific Railroad Company
Ogden, Utah
December 19, 2000

Full analytical results, for the samples presented in this report, may be found in Appendix C, and toxicological evaluations in Appendix D. All toxicity test results are summarized in Tables 1-18. A brief summary of the analytical and toxicological results follows. For the purpose of graphical clarity, non-detected concentrations are presented as the associated analysis method detection limit.

All analytical results for water are reported as micrograms of contaminant per liter of water (µg/L). With the exception of grain size analyses, all analytical results for sediment are reported as milligrams of contaminant per kilogram of sediment (mg/kg). Results of the grain size analyses are reported as percent composition. All analytical results for tissue are reported as micrograms of contaminant per kilogram of tissue (µg/kg).

The analytical results generated from the analyses of sediment and tissue are reported by the laboratories on a dry weight (d.w.) basis. The percent solids determination for each sample is also included. [The hazard quotient (HQ) method in risk assessments commonly compares site-specific contaminant concentrations with effects levels from the literature that are reported on a wet weight (w.w.) basis.] Only the analytical results for fish tissue were converted to a wet weight basis for this evaluation. The dry weight concentrations in abiotic matrices are presented in their respective tables.

3.1 Results of the Habitat Evaluation

3.1.1 Habitat Evaluation

Location WR09 received an overall score of 169 (Table 2). Optimal scores were received for epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability (left bank), bank vegetative protection (left bank), and riparian vegetation zone width (left bank); a suboptimal score was received for bank stability (right bank); and marginal scores were received for bank vegetative protection (right bank) and riparian vegetation zone width (right bank). With the exception of a dirt road parallel to the right bank, this location was situated in a relatively undisturbed area. The right bank was steep and covered with boulder rip-rap with some vegetation; the road was within 15-feet of the stream edge. The riparian vegetation had been reduced by the rip-rap and dirt road along the right bank, but the left bank was completely vegetated. The Weber River at this location was a relatively fast flowing stream dominated by riffle areas (Table 3). Pool and run areas were present, but only along the channel margins and small embayments. The substrate was composed primarily of cobble to boulder sized particles (Table 3) and the sediment was normal in appearance and odor. The Weber River at location 09 ranged to 2-feet in depth and was approximately 40-feet in width. The canopy cover was less than 5 percent. Some coarse particulate organic matter was present along the upstream sides of rocks and other obstructions.

Location WR011 received an overall score of 165 (Table 2). Optimal scores were received for epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration, and frequency of riffles, suboptimal scores were received for bank stability (both banks), bank vegetative protection (left bank), and riparian vegetation zone width (left bank); and marginal scores were received for bank vegetative protection (right bank) and riparian vegetation zone width (right bank). The dirt road present along the right bank continued to result in lower scores at this location and the stability of the right bank was compromised somewhat by the presence of a large disturbed area and piles of bare spoil and construction debris. The left bank was not disturbed and fully vegetated. The Weber River at this location was a relatively fast flowing stream dominated by riffle areas (Table 3). Pool and run areas were more common that at WR09, but were still present only along the channel margins. The substrate was composed primarily of cobble to boulder sized particles (Table 3) and the sediment was normal in appearance and odor. The Weber River at location 011 ranged to 3-feet in depth and was approximately 35-feet in width. The canopy cover was less than 5 percent. Some coarse particulate organic matter was present along the upstream sides of rocks and other obstructions.

Location WR012 received an overall score of 149 (Table 2). Optimal scores were received for epifaunal substrate/available cover, embeddedness, velocity-depth regime, channel flow status, channel alteration, and frequency of riffles; suboptimal scores were received for sediment deposition and bank stability (both banks); marginal scores were received for bank vegetative protection (both banks), and riparian vegetation zone width (both banks). At this location, the Weber River flows through a developed area; paved roads are present and the riparian area was dominated by mowed turf and ornamental plantings. The Weber River at this location was a relatively fast flowing stream but the riffle areas were reduced relative to areas further upstream (Table 3). Pool and run areas were more common, and were present in the channel as well as along the channel margins. The substrate was composed primarily of boulder sized particles but there was a greater proportion of gravel and sand sized particles at this location (Table 3). The sediment was normal in appearance and odor. The Weber River at location 012 ranged to 4-feet in depth and was approximately 35-feet in width. The canopy cover was less than 5 percent. Some coarse particulate organic matter was present along the upstream sides of rocks and other obstructions.

Location WR014 received an overall score of 136 (Table 2). Optimal scores were received for sediment deposition, channel flow status, channel alteration, bank stability (right bank), and bank vegetative protection (right bank); suboptimal scores were received for epifaunal substrate/available cover, embeddedness, frequency of riffles, bank stability (left bank), and riparian vegetative zone width (right bank); marginal scores were received for velocity-depth regime, bank vegetative protection (left bank), and riparian vegetative zone width (left bank). A paved road was present along the left bank and areas of bare soil and disturbed road shoulder were present in the riparian area. The right bank was forested and the canopy cover was 30 percent. The habitat at this location was dominated by run (Table 3) and extensive areas of fast laminar flow is present. The stream substrate was composed primarily of cobble-sized particles with substantial proportions of pebbles and coarse sand (Table 3). Coarse particulate organic matter was present in the stream. The Weber River at location 014 ranged to 4-feet in depth and was approximately 25 feet in width.

Location WR019 received an overall score of 143 (Table 2). Optimal scores were received for sediment deposition, channel alteration, frequency of riffles, and bank vegetative protection (left bank); suboptimal scores were received for epifaunal substrate/available cover, embeddedness, channel flow status, bank stability (both banks), bank vegetative protection (right bank), and riparian vegetation zone width (right bank); marginal scores were received for velocity depth regime and riparian vegetative zone width (right bank). At this location, the Weber River flows through a park; a recreational field was present along the right bank and a picnic area was present along the left bank

approximately 100-yards upstream of the sampling location. The left bank was forested, but exposed gravel bars were present along the inner portions of stream bends. The habitat at this location was dominated by riffle areas with some pools and run areas along the stream edge and in embayments (Table 3). The substrate was composed of gravel to cobble sized particles with some sand and finer particles in areas of slower flow (Table 3), and was normal in appearance and odor. The Weber River at location 019 ranged to 1.5-feet in depth and was approximately 25 feet in width. The canopy cover was less than ten percent, and very little coarse particulate organic matter was present in the stream.

Location WR024 received an overall score of 99 (Table 2). An optimal score was received for channel flow status; suboptimal scores were received for epifaunal substrate/available cover, embeddedness, and bank stability (right bank); marginal scores were received for velocity-depth regime, sediment deposition, channel alteration, frequency of riffles, bank stability (left bank), bank vegetative protection (right bank), and riparian vegetation zone width (right bank); poor scores were received for bank vegetative protection (left bank), and riparian vegetation zone width (left bank). At this location, the Weber River flows through the rail yard itself and was bordered by large areas of bare soil, dirt and paved roads, a chemical packaging facility, rail maintenance areas, and rail sidings. A narrow fringe of riparian vegetation is present along the right bank and the left bank is dominated by disturbance as noted above. The river filled the channel and stream banks were undercut in places. The habitat was primarily run with large areas of fast laminar flow (Table 3). Pools were present in embayments and a small riffle area was present approximately 20-yards upstream of the sampling location. The substrate was dominated by gravel and sand sized particles (Table 3) and was normal in appearance and odor. The canopy cover was less than 5 percent. The Weber River at location 024 ranged to 4-feet in depth and was approximately 25 feet in width. Although very little coarse particulate organic matter was present, areas of fine organic matter was present in the pools.

Location WR028 received overall score of 121 (Table 2). Optimal scores were received for epifaunal substrate/available cover, sediment deposition, and channel flow status; suboptimal scores were received for embeddedness, channel alteration, frequency of riffles, and bank stability (right bank); marginal scores were received for velocity-depth regime, bank stability (left bank), bank vegetative protection (right bank), and riparian vegetation zone width (right bank); poor scores were received for bank vegetative protection (left bank), and riparian vegetation zone width (left bank). With the exception of some sidings, this location was downstream of most active portions of the rail yard including maintenance area and lagoons and drainage ditches. The riparian area along both banks was somewhat disturbed but was vegetated with a scrub-shrub association and some scattered trees. The river flows through a well defined channel; the left stream bank was a relatively steep embankment approximately 8-feet above the waters surface whereas the right bank sloped gradually to the water surface. The habitat was primarily run with large areas of fast laminar flow (Table 3). Pools were present in embayments and backwater areas. Several riffle areas were present adjacent to gravel bars along the right bank and the inner portion of stream bends. The substrate was dominated by cobble and gravel and sand sized particles (Table 3) and was normal in appearance and odor. The canopy cover was less than 5 percent. The Weber River at location 028 ranged to 3-feet in depth and was approximately 30 feet in width. Some coarse particulate organic matter was present and fine organic matter was present in the pools.

3.1.2 Habitat Assessment

For each location, the evaluation procedure rated and then totaled the scores for individual habitat parameters (Table 2). The total score for each location was compared to the reference location to provide a habitat comparability score. When compared to upstream location WR09, the habitat at locations WR011 was assigned to assessment category "comparable to reference", locations WR012, WR014 and WR019 were assigned to assessment category "supporting", location WR028 was

assigned to assessment category "partially supporting", and location WR024 was assigned to assessment category "non-supporting". Relative to the upstream reference location, the habitat quality of the downstream locations can be ranked as follows: WR09>WR011>WR012>WR019>WR014>WR028>WR024.

3.2 Results of the *In situ* Surface Water Quality

Water quality parameters were measured (09 March 2000) using a Hydrolab Surveyor 4*a* Water Quality Management System™ at the following locations: Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, and Strongs Creek (Table 4). Surface water temperatures ranged from 1.0 °C (AOI 10-2) to 4.3 °C (Burch Creek-3). The dissolved oxygen concentrations in the surface waters only varied from a low of 10.2 mg/L (Roundhouse ditch-3) to 11.4 mg/L (AOI 10-2). There was minimal variation in pH among the locations, with all having a pH of 8.2 or 8.3 standard units. Surface water conductivity ranged from 451 µmhos (Strongs Creek-4) to 3,679 µmhos (AOI 10-2). Turbidity was greatest at location AOI 10-2 (1,000+ NTU) and lowest at Roundhouse ditch-3 (53 NTU).

3.3 Results of the Chemical Analyses of Surface Water

Surface waters collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, VOCs, Total Petroleum Hydrocarbons (TPH), hardness, TSS, and TOC (Appendix C).

Surface water concentrations of aluminum ranged from 57 µg/L (33SS1A) to 1,200 µg/L (BC3A and BVP03B). Arsenic concentrations ranged from non-detected to 5.0 µg/L (SC2A). Barium surface water concentrations ranged from 52 µg/L (OR02B) to 250 µg/L (BC3A). Surface water samples had lead concentrations ranging from non-detectable to 7.2 µg/L (BVP03A). Manganese concentration in surface water ranged from 30 µg/L (WR011A and WR012A) to 110 µg/L (33SS1A). Surface water samples were found to contain zinc at concentrations ranging from non-detectable to 21 µg/L (33SS1A). Cadmium, chromium, cobalt, copper, mercury, nickel, selenium, and silver were not detected in surface water samples analyzed.

Surface water samples collected did not have detectable concentrations of BNAs.

Acetone was the only VOC found (also found in the blank) in surface water samples, with the exception of the water sample from the seep on the bank of the 21st Street Pond. That particular sample (A0119-0325) was found to contain: 120 µg/L benzene, 230 µg/L ethylbenzene, 59 µg/L p&m-xylene, 90 µg/L o-xylene, 12 µg/L isopropylbenzene, 63 µg/L 1,3,5-trimethylbenzene, 64 µg/L 1,2,4-trimethylbenzene, and 180 µg/L naphthalene.

The water samples analyzed were found to have no detectable TPH concentrations.

Surface water hardness, expressed as mg/L $CaCO_3$, ranged from 93 mg/L (BVP03B) to 392 mg/L (BC3A). Due in part to flow and substrate differences, TSS concentrations varied widely. At the 33rd Street Slough (33SS1A), TSS was below the method detection limit of 5 mg/L, in contrast to the 23 mg/L in Burch Creek (BC3A). Surface water from the Ogden River had the lowest concentration of TOC, 1.8 mg/L (OR02B), while the sample from BVPP (BVP03B) had the highest, 5.2 mg/L.

3.4 Results of the Chemical Analyses of Sediments

Sediments collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street

Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, pesticides/PCBs, VOCs, TPH, TOC, and grain size (Appendix C).

Aluminum concentrations ranged from 920 mg/kg (AOI 4A) to 15,000 mg/kg in sediments from the 21st Street Pond (21SP04). Sediment arsenic concentrations were greatest at AOI 4 (6.1 mg/kg) and least at the 21st Street Pond seep (1.4 mg/kg). Barium concentrations ranged from 49 mg/kg (33SS2A) to 400 mg/kg (AOI 4A). Cadmium was not detected in many of the locations and the maximum recorded was 1.0 mg/kg (AOI102A). Sediment chromium concentrations ranged from 4.4 mg/kg (AOI4A) to 31 mg/kg (SC1A). The maximum recorded cobalt concentration, 7.7 mg/kg, was from a sample from the 21st Street Pond (21SP04). A sediment sample from the 33rd Street Slough (33SS2A) contained the highest copper concentration, 130 mg/kg. Lead concentrations in sediment samples ranged from 6.8 mg/kg (BC3A) to 130 mg/kg (SC1A). The maximum recorded manganese concentration, 960 mg/kg, was from a sample from the 21st Street Pond (21SP04). The sediment mercury concentrations ranged from non-detected to 0.39 mg/kg (BVP03B). Nickel concentrations ranged from 3.6 mg/kg (WR021ADUP) to 20 mg/kg (21SP04B). The maximum detected sediment selenium and vanadium concentrations were 5.0 mg/kg (AOI4A) and 24 mg/kg (21SP04B), respectively. Sediment zinc concentrations were as low as 33 mg/kg (OR02B) and as high as 200 mg/kg (RD3A). Antimony and silver were not detected in sediment samples analyzed.

The following BNAs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, carbazole, fluoranthene, pyrene, bis)2-ethylhexyl)phthalate, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. A tentatively identified compound (TIC) was recorded for the sediment/soil sample from the seep at the 21st Street pond. It was idenitified as a biphenol (920 µg/kg). Bis(2-ethylhexyl)phthalate was also found in the sediment samples from the Ogden River, Buena Ventura Park Pond, and 21st Street Pond.

Two pesticides were identified in sediments from the area. Locations SC1A and 33SS2A were found to contain g-chlordane, while p,p'-DDE was measured in sediments from 21st Street Pond seep (12 µg/kg), 21st Street Pond (4.9 to 9.4 µg/kg), and the Weber River (WR019A, 7.3 µg/kg). Only one PCB congener was positively identified. Arochlor 1260 was found at concentrations of 340 µg/kg and 1,000 µg/kg from AOI 10-2 and OR02B, respectively.

The following VOCs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): methylene chloride, benzene, 2-butanone, 4-methyl-2-pentanone, toluene, p-isopropyltoluene, naphthalene, ethylbenzene, p&m-xylene, o-xylene, isopropylbenzene, n-propylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and sec-butylbenzene. Benzene (46 µg/kg) and related compounds were found in the sediment/soil (A0119-0324) from the seep at the 21st Street Pond.

Concentrations of TPH in sediments analyzed ranged from 170 mg/kg (BC3A) to 2,200 mg/kg (WR024A).

Sediment TOC (loss on ignition) ranged from 0.61 percent (%) (WR021A) to 5.1% (WR09A).

3.5 Results of the Solid-Phase Sediment Toxicity Evaluations

A summary of the *H. azteca* survival and growth during the 14 day subchronic exposure to site sediments is presented in Table 4. The mean percent laboratory control survival was 93%. The mean

percent survival in the sediment from location WR025A was 74%; the only sample to be statistically different compared to the survival of control organisms. The mean percent survival in all of the remaining samples evaluated ranged from 91 to 100%. The mean dry weight of amphipods in the laboratory control, at day 14, was 0.15 mg per amphipod. Based on the statistically significant reduction of survival in the sediment from location WR025, organism growth from this sample was excluded from statistical analysis. The mean dry weight of amphipods in all of the site sediments tested ranged from 0.24 to 0.40 mg per amphipod, greater than that of the laboratory control organisms.

A summary of the *C. tentans* survival and growth during the 10 day subchronic exposure to site sediments in presented in Table 5. The mean percent laboratory control survival was 93%. The mean percent survival in the sediment from location WR025A was 76%; the only sample to be statistically different compared to the survival of control organisms. The mean percent survival in all of the remaining samples evaluated ranged from 81 to 96%. The mean dry weight of midge in the laboratory control, at day 10, was 0.99 mg per midge. Based on the statistically significant reduction of survival in the sediment from location WR025, organism growth from this sample was excluded from statistical analysis. The mean dry weight of midge in all of the site sediments tested ranged from 1.91 to 3.51 mg per midge, greater than that of the laboratory control organisms.

3.6 Results of the Benthic Macroinvertebrate Community Survey

Examination of raw samples indicated very high counts for all samples. In most cases, subsampling only one square was required to achieve greater than 100 organisms. In no case was more than 2 squares necessary to obtain the required 100 organisms. It was apparent from casual observation that EPT taxa (Ephemoptera, Plecoptera, Tricoptera - mayflies, stoneflies, caddisfies respectively), particularly mayflies, were dominant in most samples. Counts of the subsamples ranged from 107 to 312, representing 12 to 22 taxa, often 50% or more being EPT taxa (Table 7). The most abundant organisms were EPT taxa, and chironomids were not overly abundant in most samples.

Community metrics were calculated according to EPA protocols and are summarized by station in Table 7. There were no apparent trends in abundance or richness in either total taxa or EPT taxa. Pollution tolerant organisms were present at all stations. However, Hilsenhoff indices were high, ranging from 4.4 to 5.3. The high values are likely due to the high numbers of Beatidae mayflies, which have a Biotic Index of 5. However, the presence of these organisms is as likely due to hydraulic conditions and the large amount of vegetative matter present in the samples as it would be due to xenobiotic input. It is possible that the stream is receiving nutrient input, this could be verified by surface water chemistry. There was no apparent trend in Biotic Index between stations, nor was there a trend in either EPT:chironomid or scraper:filterer ratios. Community structure did exhibit some trends, with the percent contribution of dominant taxa decreasing downstream from a high of 60 to a low of 25-30. Again, this is likely due to the very high number of Beatidae mayflies present at the upstream stations. Taxa diversity increased relatively consistently from the upstream to the downstream stations, from a low of 1.6 to a high of 2.2.

A bioassessment was performed following USEPA protocols and comparing stations objectively utilizing standard community metrics. There were no significant differences detected between the 7 stations (Table 7).

3.7 Results of the Chemical Analyses of Fish Tissues

The fish collected (Table 8) and processed were analyzed for tissue residues of BNAs and pesticides/PCBs. Samples were also analyzed for percent lipid content. Complete analytical reports can be found in Appendix C.

There were seven BNAs identified in the fish tissue samples (Table 9). Three of the compounds commonly found were phthalates [i.e., diethylphthalate, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate], plasticizers and common laboratory contaminants (from latex gloves). The remaining detected BNAs were phenol, 4-methylphenol, bis(2-chloroethoxy)methane, and acenaphthene. Phenol (3,100 µg/kg, w.w.) was found only in the composite liver sample (0119-1230) from white suckers. Similarly, 4-methylphenol (580 µg/kg, w.w.) was only found in a single sample (0119-1239), a largemouth bass carcass. Bis(2-chloroethoxy)methane (530 µg/kg) was identified in only one sample as well (0119-1215), a common carp filet. Six samples were found to contain acenaphthene, one white sucker filet (0119-1220 = 560 µg/kg, w.w.), three white sucker carcasses (0119-1223 = 580 µg/kg, 0119-1225 = 910 µg/kg, 0119-1229 = 420 µg/kg, w.w.), and two common carp carcasses (0119-1210 = 780 µg/kg, 0119-1218 = 730 µg/kg, w.w.).

There were 5 pesticides (g-chlordane, dieldrin, p,p'-DDE, p,p'-DDD, p,p'-DDT) and one PCB congener (Arochlor 1260) residues identified in the fish tissues from the 21st Street Pond (Table 10). Two common carp filets (5.3 µg/kg, 20 µg/kg, w.w.) and one carcass (40 µg/kg, w.w.) were found to contain g-chlordane. Dieldrin was only detected in the carcasses of two trout, a brook trout (3.1 µg/kg, w.w.) and a rainbow trout (2.6 µg/kg, w.w.).

3.8 Results of the Chemical Analyses of Surface Soils

Surface soils collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, pesticides/PCBs, and VOCs (Appendix C).

Concentrations of TAL metals were relatively nominal for surface soils analyzed from the riparian zones of the Ogden Rail Yard site. Arsenic concentrations ranged from 2.1 mg/kg (RZ106 and RZ304) to 22 mg/kg (RZ407). Cadmium concentrations ranged from non-detectable (RZ304) to 7.7 mg/kg (RZ407). Chromium ranged in concentration from 7.6 mg/kg (RZ105) to 19 mg/kg (RZ407). Copper concentrations in soils analyzed ranged from 12 mg/kg (RZ105) to 80 mg/kg (RZ407). Lead concentrations ranged from 29 mg/kg (RZ304) to 940 mg/kg (RZ407). Mercury concentrations ranged from 0.03 mg/kg (21SPP03) to 0.16 mg/kg (RZ109). Nickel concentrations in soil ranged from 6.3 mg/kg (RZ105) to 19 mg/kg (RZ407). Selenium was not detected in any of the surface soil samples analyzed. Silver concentrations ranged from non-detectable to 3.5 mg/kg (RZ407). Vanadium concentrations ranged from 10 mg/kg (RZ105 and RZ110) to 22 mg/kg (RZ407). Zinc concentrations ranged from 53 mg/kg (RZ304) to 940 mg/kg (RZ407).

Bis(2-Ethylhexyl)phthalate was found to be present in six soil samples. These estimated values ranged from 240 µg/kg (RZ208DUP) to 490 µg/kg (RZ106). Surface soil from location RZ106 was also found to contain an estimated 500 µg/kg benzo(g,h,i)perylene. The sample from RZ110 resulted in many unknown tentatively identified compounds (TICs) that ranged in concentration from 870 to 11,000 µg/kg. It also contained 4,400 µg/kg chrysin.

Surface soils analyzed were found to not have detectable concentrations of pesticides/PCBs, with the exception of two samples. The surface soil from location RZ106 was found to contain 260 µg/kg Arochlor 1260. The soil from location RZ407 contained an estimated 1.8 µg/kg p,p'-DDE.

Surface soils were found to have few detectable VOCs, which included acetone, chloroform, trichlorofluoromethane, and chlorodifluoromethane. Acetone was found in five samples ranging from 2 to 18 µg/kg. However, these values are to be considered estimated and acetone was also found in the blank. Soil from location RZ107 was found to contain an estimated concentration of chloroform of 1.0 µg/kg. Trichlorofluoromethane was found at 2.2 µg/kg in the duplicate soil sample from RZ208.

All samples analyzed were found to contain chlorodifluoromethane, except those from locations RZ106, RZ109, RZ208, and RZ304.

4.0 CONCLUSIONS

4.1 Aquatic Data

The results of the survival and growth effects on *H. azteca* and *C. tentans* observed in the site sediments suggest the absence of adverse effects associated these samples, with the exception of a significant reduction in amphipod and midge survival in those organisms exposed to sediment from location WR025A. Available sediment contaminant data for location WR025A do not explain the significant mortality observed. Also, data indicates that parameters affecting bioavailability are not different at location WR025A, compared to other locations. The observed mortality should not be considered aberrant test results, being that similar results were obtained with two species. Therefore, it must be concluded that some parameter not evaluated may be the source of the observed effects. However, it is also import to recognize that while the mortality effects are statistically significant, they are not large in magnitude. Mortality within the laboratory control samples are typically deemed acceptable, for the validity of the laboratory test, if the mortality is 20% or less (80% survival). Within the test results of station WR025A the survival was 74% and 76%, and these results are statistically significant because the control survivorship was 93%, for both species, with low replicate variability.

The most abundant organisms were EPT taxa, The abundance of mayflies and stoneflies typically being indicative of good water quality. The chironomids were not overly abundant in most samples , again suggestive of good water quality, as chironomids are viewed as contaminant insensitive and high numbers can be an indication of organic loading. There were no apparent trends in abundance or richness in either total taxa or EPT taxa between stations. Community structure did exhibit some trends, with the percent contribution of dominant taxa decreasing downstream from a high of 60 to a low of 25-30. There was also a relatively consistent increase in species diversity from the upstream to the downstream stations. None of these results point towards a site specific impact on benthic community integrity. Overall, it can be concluded that there were no biologically significant differences detected between the 7 stations.

There were seven BNAs identified in the fish tissue samples: three phthalates [i.e., diethylphthalate, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate], phenol, 4-methylphenol, bis(2-chloroethoxy)methane, and acenaphthene. Most of the BNA contaminants were found in white sucker and common carp filets and carcasses. Concentrations of detected BNAs ranged from 420 µg/kg acenapthene (white sucker carcass) to Phenol (3,100 µg/kg, w.w.) was found only in the composite liver sample (0119-1230) from white suckers. Similarly, 4-methylphenol (580 µg/kg, w.w.) was only found in a single sample (0119-1239), a largemouth bass carcass. Bis(2-chloroethoxy)methane (530 µg/kg) was identified in only one sample as well (0119-1215), a common carp filet. Six samples were found to contain acenaphthene, one white sucker filet (0119-1220 = 560 µg/kg, w.w.), three white sucker carcasses (0119-1223 = 580 µg/kg, 0119-1225 = 910 µg/kg, 0119-1229 = 420 µg/kg, w.w.), and two common carp carcasses (0119-1210 = 780 µg/kg, 0119-1218 = 730 µg/kg, w.w.).

There were 5 pesticides (g-chlordane, dieldrin, p,p'-DDE, p,p'-DDD, p,p'-DDT) and one PCB congener (Arochlor 1260) residues identified in the fish tissues from the 21st Street Pond (Table 10). Two common carp filets (5.3 µg/kg, 20 µg/kg, w.w.) and one carcass (40 µg/kg, w.w.) were found to contain g-chlordane. Dieldrin was only detected in the carcasses of two trout, a brook trout (3.1 µg/kg, w.w.) and a rainbow trout (2.6 µg/kg, w.w.).

The relatively high PCB concentrations found in the fish from the 21st Street Pond (up to 4 ug/g wet wt. in a carp carcass), combined with the low sediment PCB concentrations found in the sediment suggest that the source of the PCBs is outside of the 21st Street Pond.

The lipid content of the fish filet, carcass and liver tissue was evaluated (Table 11). The lipid content of brook trout, rainbow trout, largemouth bass, white sucker, and common carp filet tissue ranged from 12 to 23 percent, 6 to 10 percent, 4 to 7 percent, 29 to 51 percent, and 6 to 22 percent, respectively. The lipid content of brook trout, rainbow trout, largemouth bass, white sucker, and common carp carcass ranged from 25 to 47 percent, 5 to 62 percent, 11 to 29 percent, 34 to 56 percent, and 13 to 31 percent, respectively. The lipid content of brook trout, largemouth bass, white sucker, and common carp liver tissue was 23, 55, 59, and 23 percent, respectively.

4.2 Terrestrial Data

Surface soils did not contain unusually high concentrations of any TAL metal, with most of the highest metal concentrations coming from the upstream riparian zone (RZ-4). Bis(2-ethylhexyl)phthalate, benzo(g,h,i)perylene, chrysin, and many unknown tentatively identified compounds (TICs) were the only BNAs found in surface soils. Most of these were recorded for samples from RZ-1. Only the surface soil from location RZ106 was found to contain 260 µg/kg Arochlor 1260. The only pesticide detected, p,p'-DDE(1.8 µg/kg) was found in the soil from location RZ407. Few of the surface soil samples were found to contain VOCs. However, acetone, chloroform, trichlorofluoromethane, and chlorodifluoromethane were detected a limited quantity in various samples.

5.0 REFERENCES

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Table 1. Summary of Bioassessment Protocol Habitat Scoring and Categories
Used for the Weber River
Ogden Rail Yard Site
Ogden, Utah

February 2001

Habitat/Parameter	Condition Rating			
	Optimal	Suboptimal	Marginal	Poor
Epifaunal Substrate/Available Cover	20 - 16	15 - 11	10 - 6	5 - 0
Embeddedness	20 - 16	15 - 11	10 - 6	5 - 0
Velocity-Depth Regime	20 - 16	15 - 11	10 - 6	5 - 0
Sediment Deposition	20 - 16	15 - 11	10 - 6	5 - 0
Channel Flow Status	20 - 16	15 - 11	10 - 6	5 - 0
Channel Alteration	20 - 16	15 - 11	10 - 6	5 - 0
Frequency of Riffles (or Bends)	20 - 16	15 - 11	10 - 6	5 - 0
Bank Stability	10 - 9	8 - 6	5 - 3	2 - 0
Bank Vegetative Protection	10 - 9	8 - 6	5 - 3	2 - 0
Riparian Vegetative Zone Width	10 - 9	8 - 6	5 - 3	2 - 0

Assessment Category	Percent of Comparability
Comparable to reference	> 90
Supporting	75-88
Partially Supporting	60-73
Non-supporting	< 58

Table 2. Summary of Bioassessment Protocol Habitat Scores for the Weber River
Ogden Rail Yard Site
Ogden, Utah

February 2001

Habitat Parameter		Sample Location						
		WR09	WR011	WR012	WR014	WR019	WR024	WR028
Epifaunal Substrate/Available Cover		18	18	17	15	13	15	16
Embeddedness		18	18	17	15	15	13	15
Velocity-Depth Regime		18	18	18	7	7	7	7
Sediment Deposition		18	18	14	16	16	10	16
Channel Flow Status		18	18	18	18	15	16	16
Channel Alteration		18	18	18	18	18	6	13
Frequency of Riffles (or Bends)		18	18	18	8	18	10	13
Bank Stability	left bank	9	8	6	6	8	5	5
	right bank	8	7	7	9	7	7	7
Bank Vegetative Protection	left bank	9	8	5	4	9	1	2
	right bank	5	5	5	9	6	5	5
Riparian Vegetative Zone Width	left bank	9	8	3	3	8	0	2
	right bank	3	3	3	8	3	4	4
Total Score		169	165	149	136	143	99	121
*Comparability to location WR09		NA	0.98	0.88	0.80	0.85	0.59	0.72

Assessment Category	*Comparability
Comparable to reference	> 90
Supporting	75-88
Partially Supporting	60-73
Non-supporting	< 58

Table 3. Summary of Instream Habitat
Ogden Rail Yard Site
Ogden, Utah

February 2001

Location	Habitat Present (%)			Substrate Composition (%)						
	Riffle	Pool	Run	Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay
WR09*	75	10	15	10	50	20	10	5	5	0
WR011	60	20	20	5	40	20	15	10	10	0
WR012	40	25	35	5	40	15	15	15	10	0
WR014	35	15	50	5	15	35	25	10	10	0
WR019	70	15	15	5	5	25	40	15	10	0
WR024	5	20	75	0	5	15	45	20	15	0
WR028	20	20	60	0	10	30	45	10	5	0

*Reference

Table 4. Water Quality Data from Hydrolab Surveyor 4*a*
Ogden Rail Yard
Ogden, Utah

February 2001

Location	Date	Temperature (°C)	DO (mg/L)	pH	Conductivity (µmhos)	Turbidity (NTU)
Burch Creek - 3	03-09-00	4.3	10.4	8.2	594	166
AOI 10 - 2	03-09-00	1.0	11.4	8.3	3679	1000+
33rd Street Slough - 3	03-09-00	2.5	10.9	8.3	469	468
Roundhouse ditch - 3	03-09-00	3.8	10.2	8.2	528	53
Strongs Creek - 4	03-09-00	3.2	11.0	8.3	451	73

TARGET SHEET

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Table 5. Results of Sediment Toxicity Tests (Hyalella azteca, n=8)
Table 6. Results of Sediment Toxicity Tests (Chironomus tentans, n=8)
Table 7. Results of the Bentic Macroinvertebrate Community Assessment

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Table 8. Fish Collected from 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Total Weight (kg)	Filet Weight (g)	Liver Weight[a] (g)	Total Length (cm)	Standard Length (cm)	Fork Length (cm)
Brook Trout	119-1182,83,84	1	273.9	41.2	38.7	36.5	38.7
Brook Trout	119-1185,86	1.1	195.9		40	37.4	40
Brook Trout	119-1236,37	0.1	32.1		20.4	18.3	20.4
Rainbow Trout	119-1198,99	0.1	28.2		21.3	19.2	20.5
Rainbow Trout	119-1200,01	0.9	222.7		40.5	39.4	40.5
Rainbow Trout	119-1202,03	1.1	188.7		40.1	39.4	40.1
Largemouth Bass	119-1187,88,89	1.4	178.9	3.9	41	35.8	39.5
Largemouth Bass	119-1190,91	0.2	84.8		28.2	24.3	27.5
Largemouth Bass	119-1192,93	0.5	121.9		33.4	29.3	32
Largemouth Bass	119-1194,95	0.5	98.7		30	26.4	28.3
Largemouth Bass	119-1196,97	0.2	85.6		26.3	22.8	25.5
Largemouth Bass	119-1238,39	0.1	55.4		24.9	21.2	24.1
White Sucker	119-1220,21,30	2.5	218.7	16.8	55.3	49.3	52.7
White Sucker	119-1222,23	1.4	231.2		46.9	41.4	44.5

Species	Sample(s)	Total Weight (kg)	Filet Weight (g)	Liver Weight[a] (g)	Total Length (cm)	Standard Length (cm)	Fork Length (cm)
White Sucker	119-1224,25	0.9	128.8		42.2	37	39.8
White Sucker	119-1226,27	1	162.1		42	37	39.5
White Sucker	119-1228,29	0.9	166		42.7	26.6	40.4
Common Carp	119-1209,10,19	1.4	238.2	18.4	47.5	39	43.5
Common Carp	119-1211.12	1.6	132.1		50	41.5	45
Common Carp	119-1213,14	2.6	161.2		59	49.5	54
Common Carp	119-1215,16	2	135.1		52	42.3	45.5
Common Carp	119-1217,18	1.5	139		50	41.5	45

Table 8 (con't). Fish Collected from 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample	Total Weight (kg)	Filet Weight (g)	Liver Weight[a] (g)	Total Length (cm)	Standard Length (cm)	Fork Length (cm)
Bluegill (n=4)	119-1233	0.094					
Bluegill (n=4)	119-1234	0.118					
Bluegill (n=3)	119-1235	0.122					
Perch (n=1)	119-1207	0.04			15.6	13.2	15
White Crappie (n=1)	119-1208	0.037			13.8	11.2	13
Red-sided Shiner (n=4)	119-1231	0.046					
Largemouth Bass (n=9)	119-1232	0.092					

TARGET SHEET

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DOCUMENT DESCRIPTION:

Table 9. Fish Tissue BNA Residues
Table 10. Fish Tissue Pesticide/PCBs Residues
Table 11. Fish Tissue Percent Lipid Content

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